Capillary Optics for Microanalysis Applications

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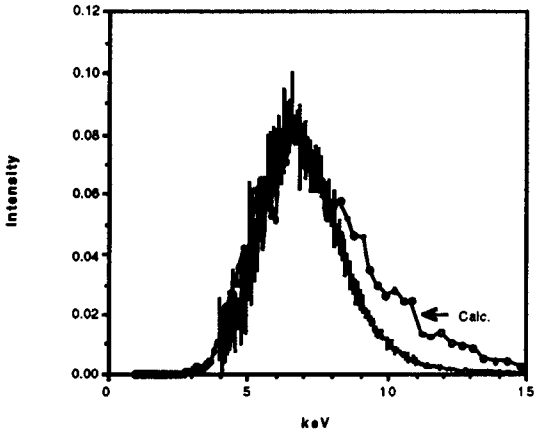
ARACOR is investigating the characterization, manufacturing techniques, and use of capillary x-ray optics in various micro-analytical and micro-imaging applications. The primary impetus for this work is the expressed needs of the electronics industry. We are relying on many people and institutions for this investigation. Outstanding among them are Reinhard Pahl (Cornell High Energy Synchrotron Source) and Brian York (IBM Corporation) who have provided the capillary manufacturing expertise and the capillaries themselves. These groups have come close to producing capillaries with ideal geometric figures (linear, elliptical, and parabolic tapers) through the use of computerized capillary pullers with feed-back mechanisms.

We have developed an automated apparatus (sine bar) based on the Kirkpatrick-Baez focusing mirror microprobe at the Advanced Light Source in Berkeley. This apparatus allows us to rotate the capillary in two axes about a central point located at the capillary entrance. Capillary alignment is performed by monitoring the x-ray throughput as the pitch and yaw are adjusted relative to the synchrotron beam.

Since no capillary is geometrically ideal, a means is needed to select the best ones for testing from among those that appear adequate. To this end, we have written a two dimensional ray tracing code to predict the performance of the capillaries, given their measured wall profiles. The code simulates actual experiments by rotating the capillary relative to the x-ray beam for maximum throughput. The code has proven to be a good screening tool in the selection of capillaries and provides a fair estimate of actual performance. We are now comparing this code with the more complete, three dimensional Monte Carlo simulation developed at the University of Antwerp (see related paper by Vincze and Janssens at this Conference).

We have tested several capillaries with a rotating anode source and with synchrotron radiation. We will report on microanalysis measurements which are now underway. Applications include: Ge-doped core of fiber optic; orientation of tungsten interconnects from Laue patterns; impurity mapping and correlation with crystal imperfections in KDP; diffraction from muscle fibers.

Figure and Table: Compare measured and calculated throughput, using a calculated ALS bending magnet input spectrum.



Capillary	Transmission	
	Measured	Calculated*
BY-1	16.5 %	19.0 %
BY-2	1.64%	5.94%

BY-1: inlet 100 μm; outlet 3.3 μm
BY-2: inlet 100 μm; outlet 1.1 μm
* 30Å roughness; energy weighted

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